The Relationship Between Physical Activity Levels and Health Anxiety

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Abstract

The majority of Americans do not meet the current physical activity guidelines that were outlined by the U.S. Department of Health and Human Services in 2008. Previous research on panic disorder and psychological constructs such as anxiety sensitivity and body vigilance indicate that individuals who experience health anxiety may be one group of people less likely to participate in physical activity, putting them at risk for a number of health issues. However, no research to date has specifically analyzed the relationship between health anxiety and physical activity levels. The present study investigated the relationship between health anxiety, psychological constructs involved in health anxiety, and physical activity. 438 undergraduate students at the University of North Carolina at Chapel Hill completed an online survey through Qualtrics software in exchange for course credit. Anxiety sensitivity (ASI-3) and depression, anxiety, and stress (DASS-21) were both negatively correlated with all levels of physical activity (aerobic physical activity, resistance training, and gym use). Additionally, experiential avoidance (AAQ-II) was negatively correlated with gym use. Body vigilance (BVS) was not correlated with any measure of physical activity. Health anxiety (SHAI) and anxiety sensitivity (cognitive concerns subscale of ASI-3) emerged as unique predictors of decreased levels of aerobic physical activity. General distress (depression subscale of DASS-21) was a unique predictor of decreased levels of resistance training. Anxiety sensitivity (physical concerns subscale of ASI-3) was a unique predictor of decreased gym use. This research adds clarity to the relationship between psychological disorders/constructs and physical activity.

Physical Activity Levels and the Role of Health Anxiety

In the last few decades, obesity rates in the United States have been on the rise. While a multitude of factors may be responsible, physical inactivity and sedentary lifestyles play a major role. Since obesity is related to a number of poor health outcomes, it is important that individuals incorporate regular physical activity into their lives (U.S. Department of Health and Human Services [HHS], 1996). Physical activity is defined as "any bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above a basal level" by the U.S. Department of Health and Human Services (HHS) (2008, p. 2). Despite this knowledge, the majority of Americans do not meet the physical activity guidelines outlined by the HHS (Brannon, Updegraff, & Feist, 2018). Physical inactivity is especially prevalent among women and individuals with low socioeconomic status or education levels (HHS, 1996).

In 2008, the HHS outlined physical activity guidelines in an effort to increase physical activity levels among Americans. Individuals 18 years and older should spend 150 minutes per week participating in moderate-intensity aerobic exercise or 75 minutes per week participating in vigorous-intensity aerobic exercise (or some combination of the two). Moderate-intensity aerobic exercise is exercise that would be reported as a 5 or 6 on a scale of 1-10 in terms of perceived exertion (e.g., gardening, brisk walking), while vigorous-intensity aerobic exercise is exercise that would be reported as a 7 or 8 on the same scale (e.g., running, swimming; HHS, 2008). Additionally, individuals should spend two days a week completing muscle-strengthening activities for all muscle groups (HHS, 2008). Aerobic physical activity is prolonged activity that uses the body's major muscles, while muscle-strengthening activities target specific muscle fibers, leading to growth of those fibers (Faust, 2016).

The HHS (2008) also created a classification system based on an individual's weekly aerobic activity. There are four different classifications: inactive, low, medium, and high. Individuals classified as inactive do not complete any activity beyond baseline (e.g., walking up and down stairs in home, doing laundry) and, therefore, do not receive health benefits. Those who complete somewhere between 0 and 150 minutes per week of moderate-intensity aerobic exercise are classified as having a low level of physical activity, and they receive some health benefits. Individuals with moderate levels of physical activity engage in 150 to 300 minutes of aerobic activity each week and receive substantial benefits. Anyone completing more than 300 minutes per week of aerobic exercise is classified as having a high level of physical activity and receives the most extensive health benefits (HHS, 2008).

In addition to its role in curbing the obesity epidemic, being physically active can lead to a multitude of other benefits, regardless of an individual's weight. For example, aerobic exercise specifically leads to cardiovascular benefits, such as a decreased resting heart rate, decreased blood pressure, and lower cholesterol levels (Faust, 2016). Resistance training, or muscle strengthening, tends to lead to many cognitive benefits, including better retention/decreased risk of dementia, stress relief, and decreased depressive symptoms (Faust, 2016). Further, it is important that individuals are active across their lifespan as benefits are seen in all age groups. Physical activity in childhood and adolescence helps promote proper bone development, and in the elderly, muscle strengthening plays a major role in fall prevention (HHS, 1996). Additionally, some benefits of physical activity, such as reduced risk for certain types of cancer and other chronic diseases, accrue with long-term physical activity. For those who are hesitant to participate in physical activity due to the potential of injury or illness, it is important to note that

research has shown that the benefits of physical activity are greater than the potential risks (HHS, 2008).

Panic Disorder and Exercise

Individuals with panic disorder suffer from recurrent panic attacks, which are episodes characterized by intense fear and strong physiological and cognitive reactions, including cardiac palpitations, breathing difficulties, chest discomfort, and fear of losing control (Sardinha, Araújo, Soares-Filho, & Nardi, 2011). While these attacks are harmless and typically brief in duration, they can be extremely distressing for individuals who experience them. Many individuals with panic disorder exhibit agoraphobia, which is the fear and avoidance of places or situations associated with previous panic attacks or places where it is plausible that one may occur (e.g., in a crowded mall) (Szabo, 2013). This disorder can have major impacts on everyday life for these individuals, which is seen when investigating the physical activity levels of individuals with panic disorder.

Prior research has indicated that people with panic disorder tend to adopt a more sedentary lifestyle than otherwise healthy individuals (Muotri & Bernik, 2014). Further, those with panic disorder have increased fear of physical activity and perform worse on tests of cardiorespiratory fitness, such as maximal oxygen uptake (Muotri & Bernik, 2014). Additional research found a positive correlation between the incidence of panic disorder and coronary artery disease. Individuals with panic disorder (as well as those with other psychological disorders) are thought to be less likely to participate in physical activity than individuals without panic disorder (Sardinha et al., 2011). However, there has been no research to confirm this belief.

Researchers have formulated a few potential explanations to address this relationship between panic disorder and lower physical activity levels. One explanation is that individuals

with panic disorder have higher levels of anxiety sensitivity (AS), which is a fear of arousal-related bodily sensations that arise in response to anxious stimuli (e.g., racing heart, breathlessness, feeling flushed; Sardinha et al., 2011; Muotri & Bernik, 2014; Hearon et al., 2014). AS could lead individuals to avoid exercise as exercise induces many of the same physiological sensations as anxious arousal (Sardinha et al., 2011). Additionally, individuals with panic disorder believe that visibly apparent changes associated with exercise and anxious arousal (e.g., sweating, flushed face) are more embarrassing than individuals without panic disorder perceive them to be. People are more likely to avoid situations that provoke feelings of embarrassment, which may explain why individuals with panic disorder would refrain from physical activity (Muotri & Bernik, 2014). The vast majority of current research consistently supports this relationship, but there is no research to date that attempts to determine the mechanism underlying it.

Conceptual Model of Health Anxiety and Relationship to Panic

For the majority of the population, health-related concerns help individuals monitor and regulate their health. They may lead individuals to schedule a doctor's appointment if they have been vomiting or to engage in other illness behaviors that are aimed at restoring their health, such as sleeping more when they have a virus (Abramowitz, Olatunji, & Deacon, 2007). However, for some, these concerns become so excessive that they lose their adaptive, regulatory function. Health anxiety occurs when an individual's thoughts and concerns about his or her health occur without any basis for these concerns. These concerns typically result from a gross misinterpretation of and overreaction to somatic sensations, such as *my heart rate is increased, so I must be having a heart attack* (Owens, K., Asmundson, Hadjistavropoulus, & Owens, T., 2004).

Rachman (2012) proposed a model explaining the cognitions involved in health anxiety. Initially, there is an overestimation of a threat, which can be regarding the likelihood of getting a particular health condition or the severity of that condition. This overestimation then leads the individual to become hypervigilant to physiological sensations that may prove this estimation of threat. The hypervigilance leads to avoidance of the sensation, which can often involve the use of safety behaviors (e.g., checking blood pressure every hour to make sure it is still normal). This avoidance leads to short-term relief, but it ultimately perpetuates the cycle as it prevents the individual from challenging the overestimation of threat. This model could explain why someone with health anxiety may avoid exercise. If an individual feels that increasing his heart rate too much will cause him to have a heart attack, he is overestimating the likelihood of getting ill. This could lead the individual to pay additional attention to his heart rate in order to monitor it at all times, which could lead to an avoidance of activities that may increase his heart rate (e.g., exercise). The individual will not have a heart attack due to increased heart rate, but he will believe that that is only because he is avoiding situations that would increase his HR.

Additionally, there are certain characteristics of panic disorder and health anxiety that are extremely similar. It is clear that health concerns form the basis of health anxiety, but these concerns also seem to be largely involved in the maintenance of panic disorder (Otto, Demopulos, Mclean, Pollack, & Fava, 1998). Specific analyses using the Short Health Anxiety Inventory (SHAI) revealed that individuals with panic disorder and health anxiety were more likely to overestimate the frequency of getting a cold but only individuals with health anxiety overestimated the consequences, or severity, of becoming sick (Abramowitz, et al., 2007). The similarities between the two conditions suggest that a phenomenon observed in one condition

(decreased physical activity in individuals with panic disorder) may extend to the other condition (health anxiety).

Maintenance of Health Anxiety

Three factors—anxiety sensitivity (AS), body vigilance (BV), and experiential avoidance (EA)—are related to the development and maintenance of health anxiety. These factors also help explain why individuals with health anxiety may tend to avoid physical activity.

AS is related to health anxiety. Abramowitz et al. (2007) found that AS (specifically the cardiovascular concerns subscale) of the Anxiety Sensitivity Index-Revised (ASI-R) was correlated with both SHAI subscales, illness likelihood and negative consequences. Additionally, further research found a correlation between the ASI and the Illness Attitudes Scale, another measure of hypochondriacal concerns (Otto et al., 1998).

Research indicates that AS is correlated with lower levels of physical activity (Hearon, Ouatromoni, Mascoop, & Otto, 2014). This correlation suggests that the distress experienced during exercise for people with high AS leads them to avoid physical activity. Further strengthening this relationship is the finding that AS is correlated with a decreased willingness to tolerate this distress (Hearon, Ouatromoni, Mascoop, & Otto, 2014). Researchers determined that the degree of fear regarding these bodily sensations plays a larger role in this decreased distress tolerance than the quantity of bodily sensations experienced (Otto et al., 1998). The relationship between AS and decreased physical activity may be mediated by weight. In individuals with high AS, higher weight individuals are more sedentary than their normal weight counterparts. However, AS only explains a portion of the variance in health anxiety symptoms, which indicates that there are other factors involved (Wheaton, Berman, & Abramowitz, 2010b).

Body vigilance, which is defined as an increased attentiveness to various bodily sensations, is another such factor that is involved in the maintenance of health anxiety (Olatunji, Deacon, Abramowitz & Valentiner, 2007). As discussed in the model above, a key component to the experience of health anxiety is the constant scanning and checking of the body for abnormal sensations. Individuals who devote increased attention to bodily sensations notice completely normal physiological changes (e.g., increased heart rate after walking up stairs) and perceive them as catastrophic (Rachman, 2012). Further research indicates that these individuals may actually have a bias that causes them to overestimate the occurrence of certain bodily sensations, which leads to further concern and greater checking (Krautwurst, Gerlach, Gomille, Hiller, and Witthöft, 2014). Abramowitz et al. (2007) found that, similar to AS, BV was also associated with SHAI scores.

Research that directly investigates the relationship between BV and exercise behaviors has yet to be conducted, but there is reason to believe that BV could also play a role in the relationship of decreased physical activity in health anxious individuals. Anxiety can produce bodily sensations (e.g., increased heart rate, shortness of breath) that mimic the sensations for which body vigilant individuals are constantly scanning; this process can create a vicious cycle. These sensations are correlated with health-related safety behaviors, which are actions aimed at reducing these physiological symptoms (Olatunji et al., 2007). Therefore, it is plausible that individuals who try to reduce these anxiety-induced symptoms would also try to reduce these symptoms in other areas of their life (e.g., by avoiding exercise).

One of the main categories of safety behaviors is avoidance, which helps explain the role of experiential avoidance as a factor in health anxiety (Rachman, 2012). EA is the avoidance of activities or sensations an individual finds distressing due to a poor tolerance of these distressing

sensations (Wheaton et al., 2010b). Although there is scant research on EA as compared to the other factors discussed, Wheaton et al. (2010b) found that EA was correlated with both AS and health anxiety. It appears that all three of these factors (AS, BV, and EA) play a role in the maintenance of health anxiety, and these factors also explain why individuals with health anxiety may have a tendency to avoid exercise.

Current Study

Despite the importance of maintaining a physically active lifestyle in order to achieve physical and psychological well being, no research to date has sought to determine if the relationship seen in individuals with panic disorder (increased panic = decreased physical activity) extends to individuals with health anxiety. The current study will look broadly at whether or not individuals with health anxiety adopt a more sedentary lifestyle, and it will define the relationship between health anxiety and exercise levels. We hypothesize that the health anxiety, anxiety sensitivity, body vigilance, and experiential avoidance will all be negatively correlated with physical activity levels, specifically the amount of time spent participating in aerobic physical activity, the number of days spent engaging in resistance training, and the amount of time spent at the gym each week However, we hypothesize that while all measures will predict decreased physical activity levels, health anxiety will predict physical activity levels over and above other measures.

Methods

Participants

680 students enrolled in an introductory psychology course at a large public university in the Southeastern United States completed an online survey using Qualtrics software in exchange for one-half hour of research credit for their course. Participants who did not complete all

measures (n = 152) were excluded from analyses. Additionally, attention checks (e.g., "Please select ‘no’ for this question,") were included in order to exclude any participants who were mindlessly clicking through the survey in order to receive credit. Any participant failing at least one of the attention checks (n = 12) was excluded from analyses, as were individuals who indicated that they may have a medical condition *as diagnosed by a doctor* (determined via the Physical Activity Readiness Questionnaire) that would prevent them from engaging in physical activity (n = 23). Additionally, a glitch in the survey caused some individuals to take the survey twice, so duplicate responses were deleted based on IP address (n = 55). Therefore, 438 responses were used in the analyses for this project.

This sample consisted of 263 women (n = 60%), had a mean age of 18.96 years (SD = 1.125), and had 224 freshmen (n = 51.1%). 64.4% of participants identified as white (n = 282), 9.8% identified as African American (n = 43), 1.6% identified as American Indian or Alaska Native (n = 7), 14.4% identified as Asian (n = 63), 0.5% identified as Native Hawaiian or Pacific Islander (n = 2), 6.8% identified as Hispanic (n = 30), 2.1% identified as a different ethnicity (n = 9), and 0.5% did not specify (n = 2). The average self-reported height of participants in this sample was 67.19 inches (SD = 4.316), and the average self-reported weight was 148.49 pounds (SD = 31.521). 50% of the sample (n = 219) met the aerobic physical activity requirements as outlined by the HHS, while 42% of the sample (n = 184) met the resistance training requirements, and 42% of the sample (n = 184) spent 2.5 hours or more at the gym each week.

Measures

Participants in this survey completed a battery of self-report measures using an online survey.

Short Health Anxiety Inventory (SHAI; Salkovskis, Rimes, Warwick, & Clark, 2002) is an 18-item measure used to assess health anxiety. Participants rate their agreement with 18 sets of statements using a scale of 0 (less health anxiety) to 3 (greater health anxiety). One such set of statements is: "I do not worry about my health," "I occasionally worry about my health," "I spend much of my time worrying about my health," and "I spend most of my time worrying about my health." Higher scores correspond to higher levels of health anxiety. The subscales of this measure have demonstrated good validity in a sample of college students (Illness Likelihood, α = .86; Negative Consequences, α = .71; Wheaton, Berman, Franklin, & Abramowitz, 2010a). This scale exhibited good reliability in the present sample, with a Cronbach's alpha of 0.81.

Anxiety Sensitivity Index (ASI-3; Taylor et al., 2007) consists of 18 items that measure an individual's levels of anxiety sensitivity. There are three subscales that correspond to physical concerns, cognitive concerns, and social concerns. Participants rate their agreement with each statement on a Likert scale ranging from 0 (very little) to 4 (very much), and statements are phrases such as "It scares me when my heart beats rapidly." Higher scores indicate greater anxiety sensitivity. In this study, the ASI-3 had a Cronbach's alpha of 0.90.

Depression Anxiety Stress Scales (DASS-21; Antony, Bieling, Cox, Enns, & Swinson, 1998) is a 21-item measure that can be used to determine an individual's level of general distress during the past week. Items are scored on a 4-point Likert scale with options ranging from 0 (did not apply to me at all) to 3 (applied to me very much). Participants are given statements such as "I found it hard to wind down." Higher scores indicate greater levels of distress. This scale had high reliability with the present sample and had a Cronbach's alpha of 0.92.

Body Vigilance Scale (BVS; Schmidt, Lerew, & Trakowski, 1997) consists of four items that measure an individual's level of body vigilance. The first three questions evaluate a

participant's agreement with statements such as "I am very sensitive to changes in my internal body sensations," on a scale from 0 (not at all) to 10 (extremely) or a scale from 0 (never) to 100 (constantly). The last question investigates how much attention individuals pay to 15 different bodily sensations (e.g., heart palpitations, numbness), which they rate on a scale from 0 (none) to 10 (extreme). Higher scores correspond to higher levels of body vigilance. With this sample, the BVS had a Cronbach's alpha of 0.93.

Acceptance and Action Questionnaire (AAQ-II; Bond, Hayes, Carpenter, Guenole, Orcutt, Waltz, & Zettle, 2011) is a 10-item measure that is used to assess experiential avoidance. All statements are rated on a Likert scale from 1 (never true) to 7 (always true) and consist of phrases such as "It's OK if I remember something unpleasant." In this case, lower scores indicate higher levels of experiential avoidance. The AAQ-II had a Cronbach's alpha of 0.66 for this sample.

Physical Activity Readiness Questionnaire (PAR-Q; Thomas, Reading, & Shephard, 1992) is used to determine an individual's capability to engage in physical activity. It consists of seven questions such as "Has your doctor ever said that you have a heart condition and that you should only perform physical activity recommended by a doctor?" Individuals who answer "yes" to any of the seven questions in the measure are encouraged to seek the advice of a medical professional before participating in physical activity.

Procedure

Individuals enrolled in introductory psychology at this university are required to earn research credits by participating in various studies run through the psychology department. These individuals receive an account through the university that they can use to view and sign up for current studies. After signing up for this study, they were provided with the Qualtrics link to

access the survey. They then completed the self-report measures, which took approximately 30 minutes. Three attention checks were placed throughout the survey to ensure that participants were fully reading the questions as they responded to the survey. The attention checks consisted of phrases such as "Please select two for this question," mixed into measures asking participants to report their feelings and cognitions. Demographic questions were placed at the end of the survey to ensure that they did not influence participants' responses to the other measures. This included questions about age, gender, height, and weight, as well as questions about participants' physical activity habits and gym use. Finally, participants read a debriefing statement explaining the purpose of this study. The researchers granted credit to all participants who took the survey, in part or in full. Analyses were carried out using SPSS software.

Analysis Plan

Data analyses proceeded as follows: First, means and standard deviations were calculated for each of the measures discussed above. Second, zero-order correlations were computed between the measures of psychological constructs and the measures of physical activity. Third, simultaneous regressions were calculated with the SHAI, ASI-3, DASS-21, BVS and AAQ-II predicting levels of aerobic physical activity, resistance training, and time spent at the gym to determine what construct(s) are unique predictors of physical activity and if each measure contributes individual variance to the prediction of physical activity. For any constructs that were significant predictors and also had subscales, further regressions were run in order to determine if any of the subscales uniquely predicted physical activity levels or gym use.

Results

Mean Scores

Mean scores and standard deviations were calculated for all of the measures used in this sample and are listed in Table 1. Sample means for each measure were comparable to means from other studies using nonclinical, student samples (Bond et al., 2011; Norton, 2007; Olatunji et al., 2007; Wheaton et al., 2010b). Additionally, 50% of participants (n = 219) in this study met the requirement for aerobic physical activity as outlined in the 2008 PAG, and 42% of individuals (n = 184) met the recommendations for resistance training. Both of these values are higher than what is observed in the general population, indicating that individuals in this sample were more physically active than the average.

Correlational Analyses

Pearson correlations were computed between the five symptom measures (SHAI, ASI-3, DASS-21, BVS, and AAQ-II) and the three measures of physical activity (hours spent doing aerobic physical activity per week, days spent doing resistance training per week, and hours spent at the gym per week). The results of these correlations can be seen in Table 2. The ASI-3 was negatively correlated with all three measures of physical activity (*r*s ranging from -.14 to -.21), and the DASS-21was also negatively correlated with all three measures (*r*s ranging from -.16 to -.17). The AAQ-II was negatively correlated with hours of gym use per week only (r = -.15).

Regression Analyses

Full statistics for all of the regression analyses can be found in Tables 3 and 4 (for scales and subscales respectively).

Predicting aerobic physical activity. In order to determine the combined and unique contributions of the SHAI, ASI-3, DASS-21, BVS, and AAQ-II in predicting the amount of time spent engaging in aerobic physical activity per week, a linear regression was conducted. Overall,

the model accounted for 7% of the variance (R^2 = .069; F(5,282) = 4.176, p = .001). The SHAI and ASI-3 emerged as unique predictors of aerobic physical activity levels (p = .028, and p = .003, respectively).

Predicting resistance training. A similar linear regression was calculated to determine how well the SHAI, ASI-3, DASS-21, BVS, and AAQ-II predicted levels of resistance training. The model accounted for 7% of the total variance (R^2 = 0.071; F(5,282) = 4.331, p = .001). The DASS was the only measure that uniquely predicted days spent engaging in resistance training (p = .003).

Predicting gym use. In order to determine how well the SHAI, ASI-3, DASS-21, BVS, and AAQ-II predicted hours of gym use each week, another similar linear regression was conducted. This model explained 9% of the overall variance (R^2 = .084; F(5,282) = 5.174, p < .001). Only the ASI-3 was a unique predictor of gym use (p = .006).

Predicting aerobic physical activity from subscales. Since the SHAI and ASI-3 were the two scales with subscales that emerged as unique predictors for aerobic physical activity levels, two linear regressions were run using the subscales of each measure to determine if any of the subscales were unique predictors. The linear regression with the SHAI subscales accounted for 0.1% of the total variance (R^2 = .001, F(2,430) = .245, p = .782), and neither the illness likelihood nor the negative consequences subscale emerged as a unique predictor (p = .924 and p = .513, respectively). For the linear regression with the ASI-3 subscales, the model accounted for 5% of the total variance (R^2 =.052, F(3,415) = 7.514, p < .001), and the cognitive concerns subscale emerged as a unique predictor (p = .002).

Predicting resistance training from subscales. A linear regression was calculated for the DASS-21 subscales to determine if any emerged as unique predictors for levels of resistance

training. Overall, the model accounted for 4% of the variance (R^2 = .040, F(3,413) = 5.801, p = .001), and the depression subscale emerged as a unique predictor (p = .003).

Predicting gym use from the ASI-3 subscales. The ASI-3 was the only subscale that emerged as a unique predictor, so a linear regression was computed using the subscales for this measure. Overall, the model accounted for 4% of the variance (R^2 = .039, F(3,415) = 5.631, p = .001). Only the physical concerns subscale emerged as a unique predictor of gym use (p = .004).

Discussion

The current study was designed to examine the relationship between health anxiety, constructs related to health anxiety (anxiety sensitivity, general distress, body vigilance, experiential avoidance), and physical activity levels in college students. Previous research has linked panic disorder to decreased levels of physical activity, and due to similarities between panic disorder and health anxiety, it seemed plausible that panic disorder's relationship to increased levels of sedentariness would extend to health anxiety. The amount of time spent engaging in aerobic physical activity each week, the number of days spent engaging in aerobic physical activity per week, and the number of hours spent at the gym each week were used as the measures of physical activity levels in this study. Aerobic physical activity, recorded in minutes, and resistance training, recorded in days per week, were measured in accordance with the recommendations outlined in the 2008 Physical Activity Guidelines for Americans (HHS, 2008).

Anxiety sensitivity and general distress were both found to be significantly and negatively correlated with all three measures of physical activity, and experiential avoidance was significantly and negatively correlated with gym use. Therefore, the first hypothesis was partially supported. Health anxiety and body vigilance, however, were not correlated with any of the three

measures of health anxiety, and experiential avoidance was only significantly correlated with one measure of physical activity (gym use).

Anxiety sensitivity and health anxiety were found to be unique predictors of aerobic physical activity levels. Upon further investigation, the cognitive concerns subscale of the ASI-3 explained the negative relationship between anxiety sensitivity and aerobic physical activity. However, neither the illness likelihood nor the negative consequences subscales of the SHAI were found to be unique predictors of aerobic physical activity levels. Rather, the combination of these two subscales predicted decreased aerobic physical activity levels. The DASS-21 was a unique predictor of the amount of resistance training individuals engaged in, and, specifically, the depression subscale of the DASS-21 uniquely explained the negative relationship between the DASS-21 and physical activity. Additionally, anxiety sensitivity was found to be a unique predictor of gym use, and the physical concerns subscale explained this relationship. All significant relationships observed were negative (an increase in the scores on psychological constructs corresponded to a decrease in physical activity levels). Therefore, the second hypothesis that health anxiety would explain decreased physical activity levels over and above other psychological constructs was only partially supported, as the SHAI was only correlated with one measure of physical activity used in this study.

Contrary to the hypotheses, the SHAI was not correlated with any of the three measures of physical activity. However, in the regression model for aerobic activity, the SHAI did emerge as a unique predictor. The model of health anxiety (overestimation of threat -> hypervigilance -> avoidance) generated by Rachman (2012) can plausibly explain why cardiac-related, health anxious thoughts may be more associated with aerobic physical activity as opposed to resistance training. Aerobic physical activity is more likely to induce sustained increases in both heart rate

and breathing rate, and these physiological sensations could trigger anxious thoughts for individuals with health anxiety. Individually, neither the illness likelihood nor negative consequences subscales of the SHAI uniquely predicted this decrease in aerobic activity; rather, the total score accounted for this relationship. However, these sensations are not necessarily induced by resistance training, and, therefore, these concerns may not affect participation in resistance training to the same degree. With respect to gym use, there is a wide array of physical activity that can be performed at the gym. Some of these types of physical activity (e.g., yoga) may even be relaxing to individuals, which could explain why gym use was not correlated with health anxiety. Some of the constructs underlying health anxiety, such as anxiety sensitivity, were also correlated with decreased physical activity, indicating that there may be a subgroup of individuals with health anxiety that are less active than their counterparts.

Previous research has linked anxiety sensitivity to decreased levels of physical activity, and the current study supported these previous findings because anxiety sensitivity was found to be negatively correlated with all three constructs of physical activity (Hearon et al., 2014). However, the current study was the first to investigate the relationship between anxiety sensitivity and specific types of exercise, in addition to the relationship between the subscales of anxiety sensitivity and physical activity. Anxiety sensitivity was only a unique predictor of aerobic activity and gym use, not resistance training. Specifically, the cognitive concerns subscale of the ASI-3 was a unique predictor of decreased levels of aerobic activity, while the physical concerns subscale was a unique predictor of gym use. As mentioned previously, resistance training does not tend to induce the sustained increases in heart rate and shortness of breath induced by aerobic exercise, which may explain the lack of relationship between resistance training and anxiety sensitivity.

Interestingly, aerobic physical activity was not correlated with the physical concerns subscale, as would have been expected following this line of reasoning. It was instead correlated with the cognitive concerns subscale, which consists of statements such as "When my thoughts seem to speed up, I worry that I might be going crazy." It is possible that as individuals engage in aerobic physical activity and overall arousal is heightened, they are not able to selectively focus on certain thoughts as well as usual. The engagement in and focus on exercise decreases the amount of attention individuals would be able to place on various outside thoughts. For many people, this is part of the appeal of exercise (i.e. stress reduction), but it may be distressing to individuals who place a large amount of emphasis on their capability to control their thoughts. The physical concerns subscale of anxiety sensitivity consists of statements such as "When my chest feels tight, I get scared that I won't be able to breath properly." Physical symptoms such as increased heart rate and shortness of breath could certainly account for the relationship between anxiety sensitivity (physical concerns) and decreased gym use, as these symptoms would be likely induced during time spent at the gym.

Previous research has yielded mixed findings on the relationship between depression, anxiety, and physical activity levels, but, in the current study, general distress was negatively correlated with all three measures of physical activity (Forsyth, Williams, & Deane, 2015; Tajik, Latiff, Adznam, Awang, and Siew, 2017). Further, the DASS-21 emerged as a unique predictor of decreased levels of resistance training. Only the depression subscale uniquely accounted for the relationship with resistance training. Major symptoms of depression include decreased energy and activity levels, so it makes sense that depression is negatively correlated with resistance training, especially since resistance training requires a lot of power and energy (Reber, Allen, & Reber, 2009). It was surprising that DASS-21 did not predict aerobic physical activity,

since health anxiety and anxiety sensitivity are both unique predictors and DASS-21 includes an anxiety subscale. General distress may not uniquely predict levels of decreased physical activity due to the range of emotions encompassed in this term and the wide variety of ways that individuals may respond to this distress. Additionally, college students may experience different types and levels of stress than the general population, so a potential relationship may have been masked due to the specific sample used.

Body vigilance was not found to be a unique predictor in the relationship to any of the measures of physical activity used in this study. This lack of relationship makes sense with respect to resistance training, as it is not as likely as aerobic exercise to induce physiological sensations such as increased heart rate and shortness of breath, to which body vigilant individuals will be hypersensitive. With respect to aerobic physical activity, it appears that the presence of body vigilance alone does not lead individuals to find these physiological sensations distressing enough that they avoid exercise altogether. While body vigilant individuals will likely notice these changes that take place during aerobic physical activity, it appears that other constructs, such as anxiety sensitivity and health anxious thoughts, play a larger role in the avoidance of aerobic physical activity.

Experiential avoidance was correlated with decreased levels of gym use only, but it did not uniquely predict the negative relationship to any of the three physical activity constructs evaluated in this study. For individuals who do have cardiac concerns related to health anxiety, the gym may be associated with distressing memories of instances where they experienced increased heart rate or shortness of breath, leading them to avoid it altogether.

Limitations

This study had multiple limitations that should be considered. First, since this survey was a convenience sample of college students enrolled in introductory psychology, it is difficult to generalize these results to the population as a whole due to the specific target of the sample population. The sample in this study was more active than the general population, so it is also possible that some relationships may have been masked by this factor.

Additionally, all responses to this survey were collected online, as opposed to having individuals come in to the laboratory setting to have the survey administered by a researcher. Therefore, the researchers were unable to answer any questions that participants may have had about the survey. While attention checks were included throughout the survey, there was no way to ensure that individuals were not filling out the survey while distracted through the use of phones, music, television, or other methods.

This study was also limited by the inability to differentiate between the specific types of health anxious thoughts individuals experience. The SHAI targets only the *degree* of anxious thoughts individuals have, not the content of these thoughts. Therefore, it was not possible to examine the specific effects of cardiac concerns on physical activity, which may be greater than health anxious thoughts overall. Further, the measures of physical activity were not selected from a scientifically validated measure. The International Physical Activity Questionnaire (IPAQ) was included and intended to be used for this purpose, but many participants did not answer the majority of questions on this measure, so it was excluded and the questions based on the PAG were included instead.

Lastly, due to the design of this study, only correlational implications can be drawn about the relationships between variables. It is not possible at this time to determine if causality exists in this relationship or the directionality of the relationship between the psychological constructs

and levels of exercise. Due to the inability/unethicality of altering these psychological constructs in individuals, it would be difficult to determine a causal relationship in either direction.

Implications

There are multiple important health care applications emerging as a result of this research. Health anxiety seems to be associated with lower levels of aerobic physical activity, as is anxiety sensitivity, which plays a role in many psychological disorders. These findings also strengthen the hypothesis of previous researchers that suggested the relationship between panic disorder and decreased levels of physical activity is mediated by anxiety sensitivity (Sardinha et al., 2011). It is important for psychologists to be aware of these potential relationships to decreased levels of physical activity due to the numerous benefits of physical activity on both physical and mental health (Faust, 2016). Much research to this point has investigated the relationship between health anxiety and other psychological conditions, but, as evidenced by this study, there should also be a focus on its relationship to physical conditions in future research.

In the future, researchers should attempt to look specifically at the *types* of health concerns that individuals experience and how they relate to levels of physical activity to better test the hypotheses of the current study. It is also important to replicate this study with a sample more representative of the general population and with a clinical sample in order to determine if this sample has significantly lower levels of physical activity than their healthy counterparts.

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Table 1

Mean Scores of Study Measures

	N	Mean	Std. Dev.	Min.	Max.
SHAI	433	14.64	5.84	0.00	34.00
SHAI_IL	433	11.65	5.09	0.00	29.00
SHAI_NC	437	3.00	1.93	0.00	10.00
ASI-3	419	19.50	12.04	0.00	65.00
ASI_CC	436	4.64	5.11	0.00	22.00
ASI_PC	430	5.65	4.84	0.00	21.00
ASI_SC	428	9.41	4.93	0.00	24.00
DASS-21	417	14.64	10.90	0.00	48.00
DASS_Dep	429	4.63	4.39	0.00	21.00
DASS_Anx	431	4.02	3.81	0.00	19.00
DASS_Str	430	6.09	4.24	0.00	19.00
BVS	393	15.46	6.77	0.27	37.47
AAQ-II	341	33.31	8.08	10.00	59.00

Notes: SHAI = Short Health Anxiety Inventory, SHAI_IL = SHAI Illness Likelihood Subscale, SHAI_NC = SHAI Negative Consequences Subscale, ASI-3 = Anxiety Sensitivity Index, ASI_CC = ASI Cognitive Concerns Subscale, ASI_PC = ASI Physical Concerns Subscale, ASI_SC = Social Concerns Subscale, DASS-21 = Depression Anxiety Stress Scales, DASS_Dep = DASS Depression Subscale, DASS_Anx = DASS Anxiety Subscale, DASS_Str = DASS Stress Subscale, BVS = Body Vigilance Scale, AAQ-II = Acceptance and Action Questionnaire

Table 2

Correlations Between Study Measures

	Aerobic Physical Activity	**Resistance Training**	**Gym Use**
SHAI	-.022	-.011	-.032
ASI-3	-.207**	-.137**	-.175**
DASS-21	-.166**	-.166**	-.156**
BVS	-.002	.031	.027
AAQ-II	-.102	-.105	-.146**

Notes: ** $p < .01$

Table 3

Regressions Predicting Physical Activity Levels and Gym Use

Variable	R^2	*B*	β	t	p
Predicting Amount of Aerobic Physical Activity Per Week					
Total Model	.07				.001**
SHAI		.026	.155	2.204	.028*
ASI-3		-.017	-.220	-3.013	.003**
DASS-21		-.012	-.139	-1.865	.063
BVS		.005	.032	.489	.626
AAQ-II		.004	.031	.410	.682
Predicting Number of Days of Resistance Training Per Week					
Total Model	.07				.001**
SHAI		.016	.108	1.529	.127
ASI-3		-.007	-.098	-1.341	.181
DASS-21		-.018	-.221	-2.975	.003**
BVS		.013	.097	1.495	.136
AAQ-II		-.004	-.034	-.447	.655
Predicting Hours of Gym Use Per Week					
Total Model	.09				< .001**
SHAI		.021	.114	1.624	.105
ASI-3		-.018	-.199	-2.748	.006**
DASS-21		-.009	-.093	-1.264	.207
BVS		.010	.064	.993	.322
AAQ-II		-.016	-.115	-1.535	.126

*p<.05
** p<.01

Table 4

Regressions (of Subscales) Predicting Physical Activity Levels and Gym Use

Variable	R^2	*B*	β	t	p
ASI Subscales as a Predictor of Amount of Aerobic Physical Activity					
Total Model	.05				< .001**
ASI_CC		-.037	-.192	-3.13	.002**
ASI_PC		-.009	-.046	-.758	.449
ASI_SC		-.002	-.011	-.192	.848
SHAI Subscales as a Predictor of Amount of Aerobic Physical Activity					
Total Model	.001				.782
SHAI_IL		-.001	-.005	-.095	.924
SHAI_NC		-.016	-.032	-.654	.513
DASS Subscales as a Predictor of Days of Resistance Training					
Total Model	.04				.001**
DASS_Dep		-.041	-.203	-2.985	.003**
DASS_Anx		-.017	-.073	-1.049	.295
DASS_Str		.017	.082	1.102	.271
ASI Subscales as a Predictor of Hours of Gym Use					
Total Model	.04				.001**
ASI_CC		-.006	-.030	-.485	.628
ASI_PC		-.039	-.176	-2.883	.004**
ASI_SC		-.001	-.006	-.106	.915

Notes: ASI_CC = Cognitive Concerns Subscale, ASI_PC = Physical Concerns Subscale, ASI_SC = Social Concerns Subscale, SHAI_IL = SHAI Illness Likelihood Subscale, SHAI_NC = SHAI Negative Consequences Subscale, DASS_Dep = Depression Subscale, DASS_Anx = Anxiety Subscale, DASS_Str = Stress Subscale

** $p<.01$